Shape asymmetry of rogue waves

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Direct numerical simulations of the directional sea surface gravity waves are carried out within the framework of the primitive potential equations of hydrodynamics using the High Order Spectral Method. The data obtained for conditions of deep water, the JONSWAP spectrum, and various wave intensities are processed and the results are discussed. The statistical and spectral characteristics of the waves evolve over a long period. The particular asymmetry of the profiles of rogue waves is highlighted. We show that besides the conventional crest-to-trough asymmetry of nonlinear Stokes waves, the extreme events are characterized by a specific combination of the troughs adjacent to the large crest, so that the trough behind the crest is typically deeper than the preceding trough. Surprisingly, the extreme wave crest-to-trough asymmetry and the discrimination between the extreme wave troughs exhibit the tendency to grow when the angle spectrum broadens. This effect contradicts the expectation based on the Benjamin – Feir Index that broad-banded waves should behave similar to linear waves, and hence the asymmetries should diminish.

A. Kokorina, A. Slunyaev, The effect of wave nonlinearity on the rogue wave lifetimes and shapes. Proc. 14th Int. MEDCOAST Congress on Coastal and Marine Sciences, Engineering, Management and Conservation (Ed. E. Ozhan), Vol. 2, 711-721 (2019).